WET-PROCESS HIGH STRENGTH PHOSPHORIC ACID PRODUCTION FROM EGYPTIAN PHOSPHATE CONCENTRATES

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MOHAMED HESHAM HASSAN MAHMOUD
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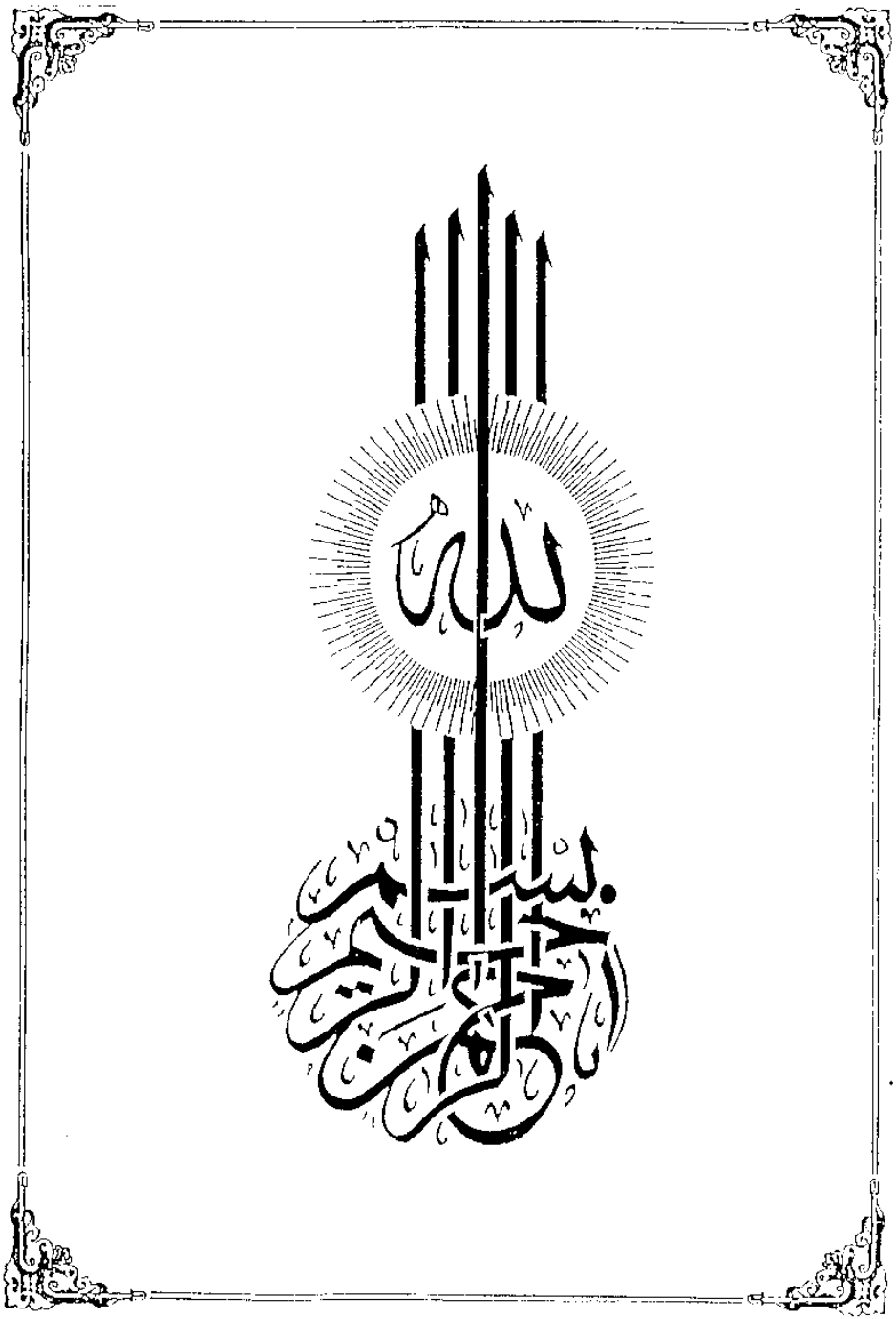
بسم الله الرحمن الرحيم

﴿ فأما الزبد فيذهب جفاءً وأما ما ينفع الناس فيمكث في الأرض ﴾

« صدق الله العظيم »



Wet-Process High Strength Phosphoric Acid Production From Egyptian Phosphate Concentrates

Thesis Advisors

1- Prof.Dr. M.F. El-Shahaat

2- Prof.Dr. I.F. Hewaidy

3- Prof.Dr. A.K. Ismail

Thesis Approved

I. F. Hewaidy

A. K. Ismail

Prof.Dr. A.M. Rabea

Head of Chemistry Department

NOTE

Beside the work carried out in this thesis, the candidate, Mohamed Hesham Hassan has attended post-graduate studies for the partial fulfillment of the M.Sc. degree in the following topics :

1. Advanced Inorganic Chemistry
2. Computer in Chemistry
3. Chromatography and Ion Exchange
4. Electrochemistry
5. Group Theory
6. Instrumental Analysis
7. Nuclear Chemistry
8. Molecular Structure
9. Organometallic Compounds
10. Solvent Extraction

He successfully passed an examination in the above-mentioned courses.

Head of Chemistry Department

Faculty of Science

Ain-Shams University

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CONTENTS

A B S T R A C T

Egyptian phosphate concentrate from "Sebaiya West" was processed to produce phosphoric acid by the Hemihydrate-dihydrate process. Batch and continuous tests were performed. Batch scale tests were carried out to determine the optimum operation conditions which were used for start-up of the continuous operation. These conditions comprise particle size, temperature, time, sulfuric acid concentration and slurry seed ratio. A computer program was developed to determine the feeding rates of a continuous unit 12 kg rock/day. Acid of 49% P_2O_5 was directly produced with reaction efficiency of 97.4% and P_2O_5 recovery of 96.9%. The filtration rates were 2.7 and 4.9 tonnes $P_2O_5/m^2.day$ for hemihydrate and dihydrate stages, respectively. The results achieved are within the industrial limits.

The distribution of impurities between product acid and gypsum cake was studied. The product acid was clarified and the clarification sludge was investigated. Mass and component balances were made and the processing flowsheet was recommended.

CHAPTER I

INTRODUCTION

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Phosphoric acid plays an important role as an intermediate in the production of phosphate fertilizers and in other areas of chemical industry. The world production of phosphoric acid from phosphate rocks continues to rise. Already there is concern that in meeting this demand, a modification of the traditional technique for the production of phosphoric acid with less consumption of phosphate rock and sulfuric acid, reduction of the energy consumption and usable by-product, is of a great need.

Traditionally, phosphoric acid has been mostly produced by the dihydrate process under reaction conditions suitable for producing low strength phosphoric acid and precipitation of calcium sulfate in the dihydrate form. The phosphoric acid produced is of low P_2O_5 content (28-30%) which is then concentrated by evaporation to 50% P_2O_5 acid.

The recent Hemihydrate-dihydrate process is based on the interaction of phosphate rock with sulfuric acid and recycled phosphoric acid, then filtration of the slurry to produce directly concentrated phosphoric acid of 40-52% P_2O_5 and gypsum in the hemihydrate form which is recrystallized to produce dihydrate cake, thus increasing the recovery and decreasing the P_2O_5 losses.

The present study aims to evaluate the Egyptian phosphate concentrate from Nile Valley (Sebaiya-West) for the production of high strength phosphoric acid by Hemihydrate-dihydrate process.

Laboratory-scale batch tests were first performed and the various factors affecting the process were studied. The optimum conditions obtained from the laboratory-scale batch tests were used as the input data in developing a computer program for calculating the feeding rates and determining the initial operation parameters of a bench-scale continuous unit, 12, kg rock/day capcity.

The objective of the continuous tests is to determine the production parameters required for industrial processing of this concentrate, e.g. feeding rates, reaction efficiency, P_2O_5 recovery, filtration rates, washing efficiencies, corrosion rates, quality of product acid and gypsum cake as well as consumption and production patterns. All these parameters were studied and the results were compared with the industrial values obtained from the processing of standard phosphate rocks (Florida or Morocco) by the hemihydrate-dihydrate process.

Finally, the material balance based on the recommended flowsheet for phosphoric acid production by the hemihydrate-dihydrate process was made.

I.1. PHOSPHATE ROCKS IN EGYPT

I.1.1. Occurrences

Phosphates in Egypt are found in three main regions; namely[1] :

- The Nile Valley, between Idfu and Wadi Qena;
- The Red Sea Coast, between Safaga and Quseir;
- The New Valley (Abu-Tartur Plateau) in the Western Desert.

In addition, phosphate-bearing sediments are encountered in Dungul, Kurkur and Bahariya Oases, between Wadi Qena and Wadi-Araba, in Esh El-Mallana range and in Sinai Peninsula, Fig. (1).

(i) Nile Valley Phosphates

El-Mahamid phosphate deposit at Sebaiya is situated on both banks of the Nile Valley (Sebaiya-West and Sebaiya-East), some 70 km south of Luxor between the towns of Isna and Edfu. The total mineral potential[2] of El-Mahamid deposits is estimated as 32.2 million tons of recoverable phosphate rock of which the Qurayat and Hagoria deposit amounts 22.3 million tons with an average P_2O_5 content of 23.01%.

Abdel-Khalek[3] found that francolite - $(Ca,Na,Mg)(PO_4)_{6-x}(CO_3)_xF_Y(F,OH)_2$ - is the main phosphate mineral of the Nile Valley phosphate rock and quartz is the most abundant gangue mineral. Calcite represents the carbonaceous impurity in the rock, whereas gypsum, anhydrite, hematite

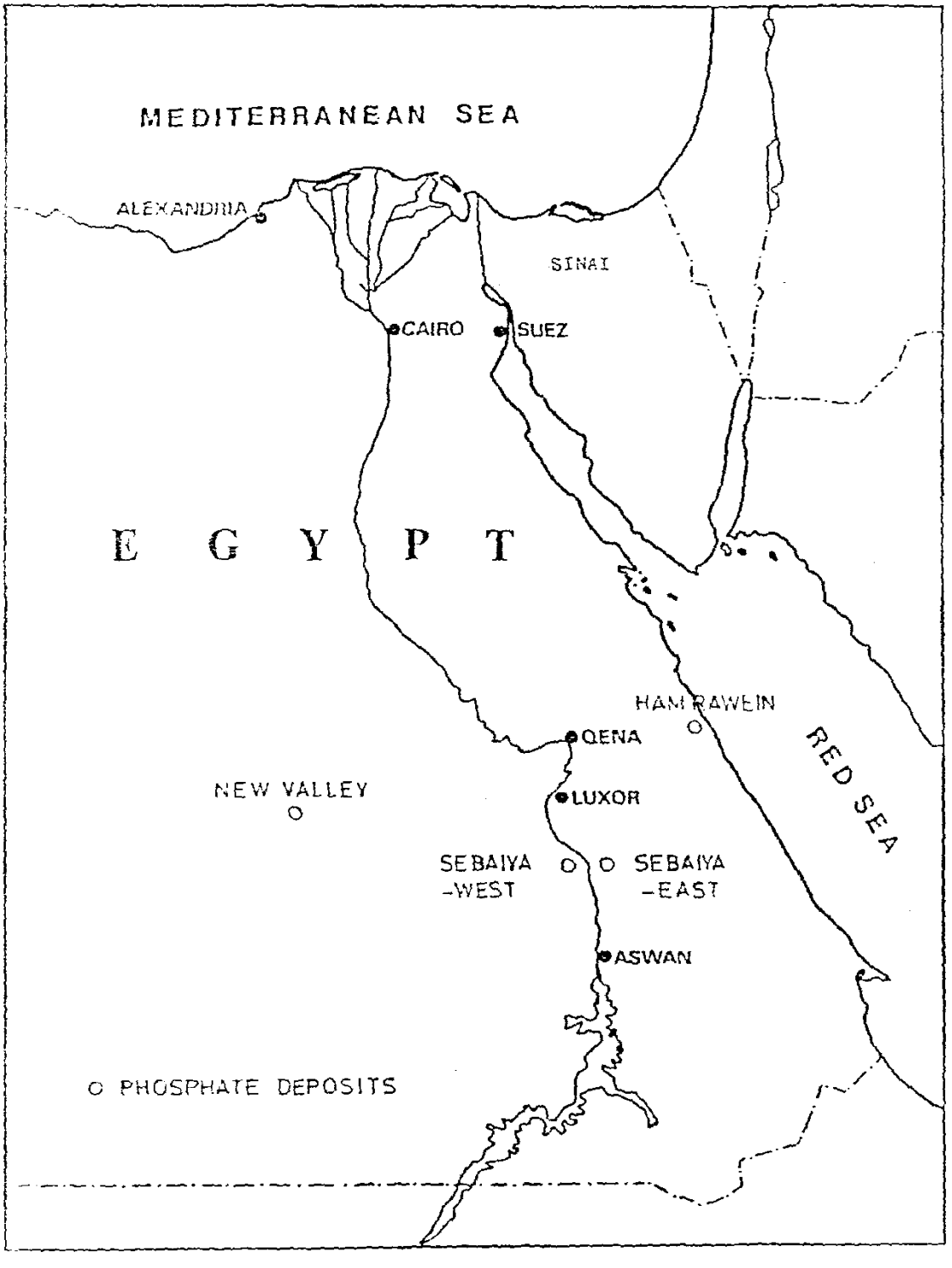

Fig. (1) : The main phosphate deposits in Egypt.